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Giemsa C-banded Karyotypes in Two Diploid and Two Tetraploid *Allium* Species

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*Allium*屬 二倍體 2種과 四倍體 2種의 Giemsa C-分染核型

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ABSTRACT

C-banded karyotypes in *A. anisopodium, A. sacculiferum, A. deltoide-fistulosum* and *A. splendens* were investigated. The chromosome compositions were diploid of 2n=16 in *A. anisopodium* and *A. splendens, and tetraploid of* 2n=32 in *A. sacculiferum* and *A. deltoide-fistulosum*. The bands were distributed in telomeric parts of the chromosomes dominantly in addition to interstitial regions sporadically, resulting in the specific C-banded karyo types according to the species. No centromeric band was observed in these species except only one chromosome in *A. deltoide-fistulosum*. The interspecific relationship based on the C-band distribution will be discussed.

INTRODUCTION

Over ten entities of the genus *Allium* including unidentified species are known to be distributed in wild population of Korea(Yu, *et al.*, 1981), and because their similarities in external morphologies and conventional karyotypes excepting some species they are supposed to be very closely related in plant evolutionary position.

Chromosome banding techniques have been widely applied to establish the interspecific relationship based on the banding appearance of various species(Schweizer and Ehrendorfer, 1976; Linde-Lausen *et al.*, 1986; Cai *et al.*, 1987; Hesemann *et al.*, 1987; Hainer and Hesemann, 1988; Song, 1987). In the genus *Allium*, C-banding patterns were reported in many species over the world(Stack and Clarke, 1973; El-Gadi and Elkington, 1975; Vosa, 1976a,b; Al-Sheikh Hussain and Elkington, 1978; Kaneko and Tashiro, 1982; Kalkman, 1984; Cortes and Escalza, 1986; Nishitani and Yabuno, 1986; Cai and Chinnappa, 1987) and in some species from Korea(Seo and Kim, 1975; Seo, 1977; Seo *et al.*, 1989).

The present paper describes the C-banding patterns of the two diploid and two tetraploid *Allium* species, and this is a part of the study investigating the phylogenic relationship of the

Korean *Allium* species on the basis of the heterochromatin amount and distribution.

MATERIALS AND METHODS

The plant materials employed in this study are shown in Table 1. The identification of each species was accomplished according to the criteria of Yu *et al.*(1981). The detailed procedures to obtain the conventional stained and C-banded karyotypes were described in the previous papers(Seo *et al.*, 1989). C-banding patterns were analyzed through metaphases showing maximum banding on at least ten individuals in each species.

Table 1. Plant materials used in this stdy

Species	Somatic Chromosome (2n)	Collection site
Allium anisopodium	16	Prov. Chungbuk Sokri Mt.
A. sacculiferum	32	Prov. Jeonnam Naro Is.
A. deltoide-fistulosum	32	Prov. Jeonnam Donkyeri
A. splendens	16	Prov. Gyungbuk Bisl Mt.

RESULTS

The chromosome compositions are diploid of 2n=16 in *A. anisopodium* and *A. splendens*, and tetraploid of 2n=32 in *A. sacculiferum* and *A. deltoide-fistulosum*. *A. anisopodium* and *A. sacculiferum* have one pair of sat-chromosomes whereas two pairs in *A. splendens* and *A. deltoide-fistulosum*. The chromosome components in basic genomes in conventional stained metaphase of *A. anisopodium* and *A. deltoide-fistulosum* show almost the same morphologies which reveal the continuous transition in size ranging from 6.2 to 12.8 μm and identical types of centromeric positions between comparable homoeologous chromosomes including one sat-chromosome. But those of *A. splendens* are clearly distinguished in which two subtelocentric sat-chromosomes exist in a basic genome. On the other hand, the four genomes in *A. sacculiferum* are constituted as two genomes are same with those of *A. anisopodium* or *A. deltoide-fistulosum* but the other two genomes are discriminated as no subtelocentric sat-chromosome exists.

C-banding patterns of the four species are species-specific and enough as a means of the species identification. Centromeric parts, which generally considered to consist of constitutive heterochromatin and so frequently display C-bands, revealed no C-band in all four species. The details on the C-banding patterns are as follows.

Allium anisopodium; The C-banded metaphases and idiograms are shown in Figs.1 and 2. The C-bands occupy about 7.0% of the total chromosome length and appear in the telomeric or interstitial parts of the chromosomes. Three pairs of the chromosomes(a, b, c) show no band except very thin telomeric bands appeared occasionally in repeated experiments and

Fig. 1. C-banded metaphase plates of *A. anisopodium*(A), *A. sacculiferum*(B), *A. deltoide-fistulosum*(C) and *A. splendens* (D). arrows: sat-chromosomes.

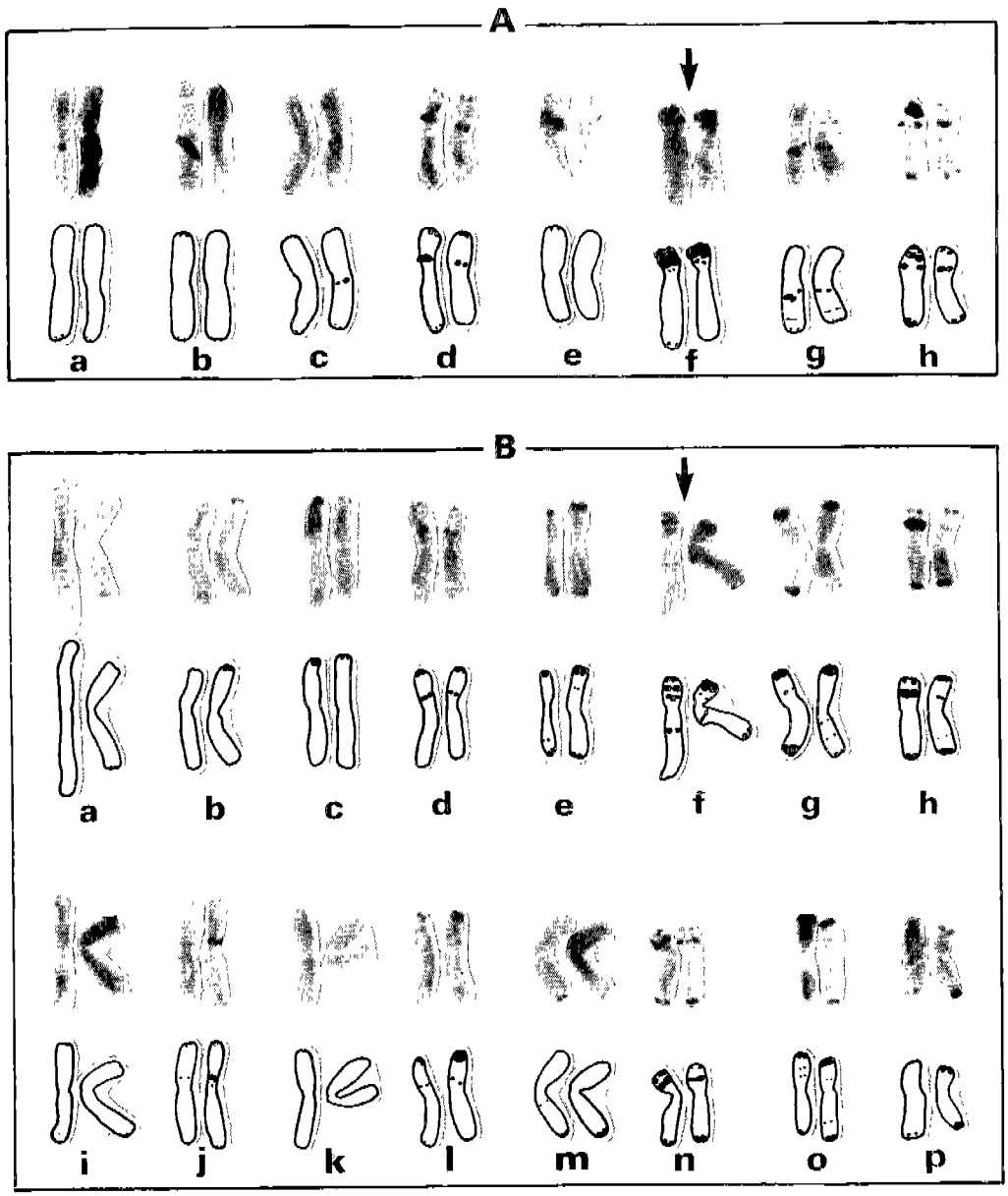

Fig. 2. C-banded idiograms and their diagrams of *A. anisopodium* (A) and *A. sacculiferum*(B). arrows: sat-chromosomes.

chromosomes c, d and g have relatively thick intersitial band near the centromere in the long or short arm. The distinct telomeric bands are observed in the short or long arm, or both arms of chromosomes d, f and h. The sat-chromosomes and the shortest chromosomes(h) show

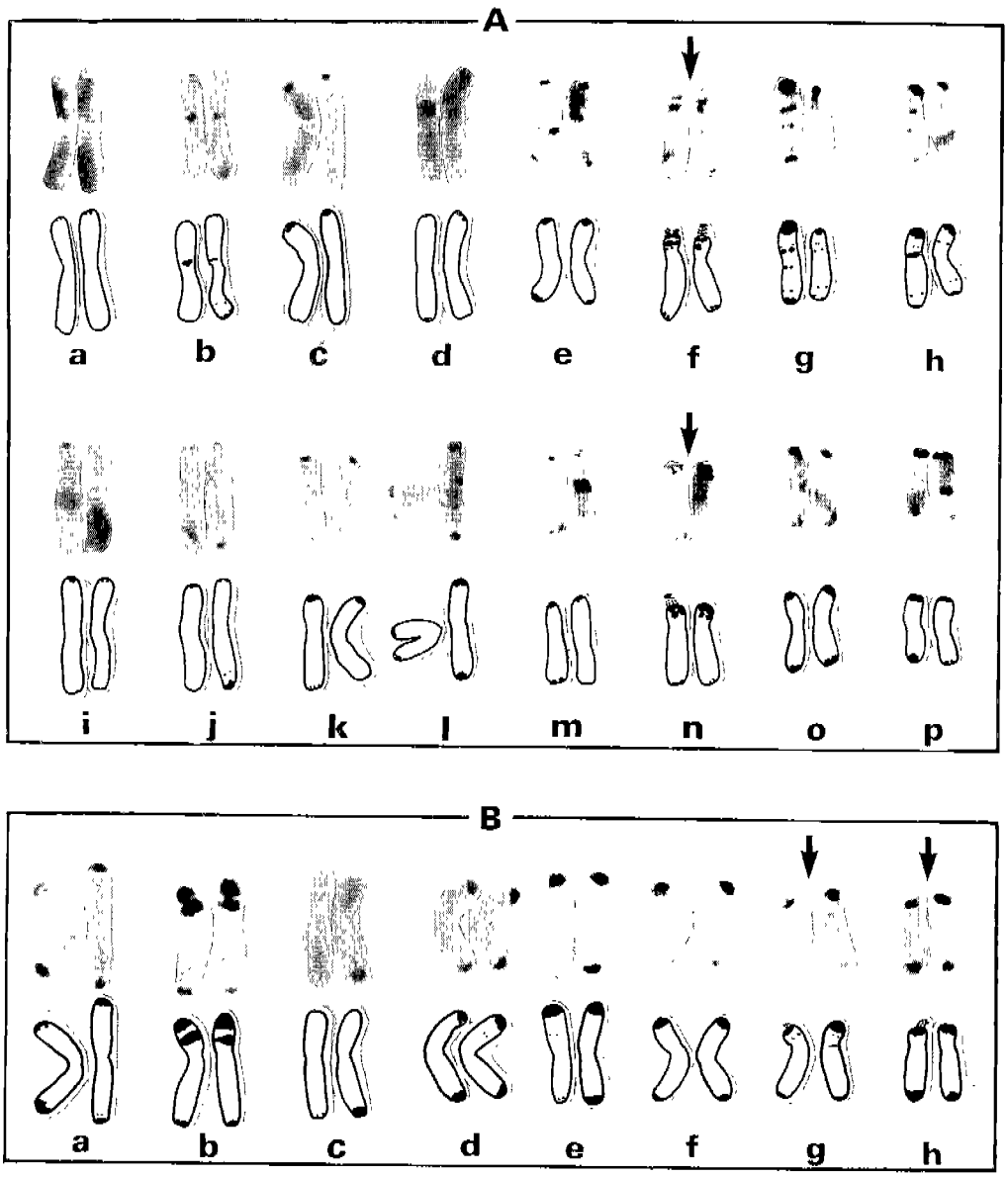

Fig. 3. C-banded idiograms and their diagrams of *A. deltoide-fistulosum*(A) and *A. splendens*(B) arrows: sat-chromosomes.

distinct interstitial bands in the short arms and the satellites are observed as dark bands. The same homologous chromosomes display almost identical banding pattern except chromosomes c and h in which the interstitial bands in the long arm and short arm showed variation within homologous chromosomes.

Allium sacculiferum; This species seems to be allotetraploid considering the band distribution and the presence of only one pair of sat-chromosomes (Figs.1 and 2). Three pairs of chromosomes(a, i and k) appear non-banded and the rest show distinct telomeric and interstitial bands. Only one pair of sat-chromosomes(f) are observed in spite of tetraploid genome composition and these contain distinct band in the short and long arms, and the satellites appear banded. The band appearance is more of less variable within homologous chromosomes(b, e, f, g, h and p). The C-bands measured 8.2% of the total chromosome length.

Allium deltoide-fistulosum; In previous paper the C-banded karyotypes of the diploid *A. deltoide-fistulosum* was reported, and same species investigated in this study which is endemic species in limited area of Jeonnam-Donkyeri is turned out to be tetraploid. About 8.3% of the total genome length is banded and the bands are observed in all the chromosomes in telomeric parts dominantly and interstitial parts according to the individual chromosomes although only very thin telomeric bands exist in chromosome pair a. Two pairs of sat chromosomes(f and n) display the same C-banding patterns as telomeric bands in both arms and interstitial bands in the short arms including banded satellites. Banding difference is observed within homologous chromosomes(g, h, j, m and p)(Figs.1 and 3). Only one chromosome showed centromeric band in chromosome pair h.

Allium splendens; The conventional karyotype of this species is significantly different from those of other diploid *Allium* species reported previously(Seo *et al.*, 1989) in that two subtelocentric sat-chromosomes are contained in a basic genome, and C-banding patterns also show considerable differences. The band amount measured about 14.0% of the total chromosome length and very thick telomeric bands are observed in all the chromosomes except one of the chromosome pair c. No distinct interstitial band appears except very thick bands in the short arms of chromosome b but minor interstitial bands are observed in chromosomes a, d, e and g. Two pairs of sat-chromosomes can be distinguished each other by C-banding appearance. The minor interstitial bands in the short arms and relatively thin telomeric bands in the long arms of chromosome pair g are different from chromosome h, and another interstitial band in the long arm near centromere is found in one of the chromosome pair g.

DISCUSSION

The C-banded karyotypes of the four *Allium* species were investigated. Each species showed unique banding pattern but the same types of bands also appeared between homocologous chromosomes of different species. Among four species, *A. anisopodium* and *A. deltoide-fistulosum* contained the same constitution of basic genome including one sat-chromosome with conventional staining, and the banding patterns in some chromosomes were common in these species. On the other hand, *A. splendens* revealed different chromosome composition in conventional stained basic genome including two sat-chromosomes and nonrelated banding pattern com-

pared with those of above species. In addition, *A. sacculiferum* showed another constitutions in for genomes, but the C-banding patterns of some homologous chromosomes were considerably related with those of *A. anisopodium* or *A. deltoide-fistulosum*. Consequently three species except *A. splendens* seemed to be considerably related in evolutionary position, and *A. splendens* progressed different evolutionary pathway.

The C-banding pattern of tetraploid *A. deltoide-fistulosum* was almost doubled with that of the diploid species reported in previous paper(Seo *et al.*, 1989). But whether this tetraploid species is auto- or allotetraploid is not clear only with this result.

Kurita(1955) reported the chromosome composition of *A. splendens* as tetraploid and the basic karyotype of this species was identical with that of *A. togashii* Hara(Nishitani and Yabuno, 1986) containing diploid chromosome composition. *A. splendens* investigated in this study turned out to be diploid with 2n=16 and the conventional karyotype was nondiscriminated with that of *A. togashii*. But considerable differences were observed on the C-banding patterns between the two species, and this result was fully enough to distinguish each species. The details on the phylogenic relationship of the *Allium* species distributed in Korea are due to be elucidated on the basis of the banding amount and patterns in each species in the further report.

적 요

실부추, 참산부추, 세모부추, 돌부추의 Giemsa C-분염 핵형을 조사한바 실부추와 돌부추는 염색체 구성이 2n=16의 이배체였고 참산부추와 세모부추는 2n=32의 사배체였으며 C-분염은 종에 따라 특이적이었다. 분염은 염색체 말단에 주로 나타났으나 완의 중간에도 일부 나타났으며 동원체 부위에는 세모부추의 단 하나의 염색체 외에는 나타나지 않았다. 분염 양상에 근거하여 종간 유연관계를 추적할 수 있었다.

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